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GEOMETRICAL CHARACTERISATION OF INDIVIDUAL FIBRES FROM X-RAY TOMOGRAMS

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Abstract. Numerous modelling possibilities are opened up by an advanced image analysis pipeline that can accurately extract individual fibres from X-ray tomograms.

Keywords: X-ray tomography, Individual Fibres, Unidirectional Composites, Modelling.

We have developed an image analysis pipeline[1] that can extract individual fibre tracks from low contrast X-ray tomograms of unidirectional composites with high fibre volume fraction. Measuring individual fibre tracks opens up the possibility of modelling this empirical data in a statistical manner. Thus, allowing to analyse the spatial distributions of the parameters characterising the orientation and curvature of these individual fibres, which can also provide insights on the interactions amongst the individual fibres.

Finite element models (FEMs) can be built from the extracted geometry to simulate the performance of the scanned fibre structure under realistic conditions. Moreover, aspects of the fibre architecture that influence the macroscopic behaviour of the composite can be quantified. Examples are 2D FEMs to predict the transverse stiffness[2] or the quantification of fibre orientations to estimate the compression strength.[1] And last but not least, already developed analytical and numerical models to describe the composite's behaviour can be validated against the observed data.

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